INTERIM

PROGRAM OF STUDIES

CHEMISTRY

CURRICULUM

LB
1629.5
A3
A35
1978
gr.10-12
add.chem.
1988

ALTA
373.19
1978
gr.10-12
add.chem.
1988

CURR

CURRGDHT

DRAFT 88 09 15

Digitized by the Internet Archive
in 2012 with funding from
University of Alberta Libraries

http://archive.org/details/shschemistry203088albe

INTERIM

PROGRAM OF STUDIES

CHEMISTRY

CURRICULUM

LB
1629.5
A3
A35
1978
gr.10-12
add.chem.
1988

CURR HIST

ALTA
373.19
1978
gr.10-12
add.chem.
1988

CURR

DRAFT 88 09 15

QUAECUMQUE VERA
EX LIBRIS
UNIVERSITATIS
ALBERTÆNSIS

GOALS AND OBJECTIVES

Goal 1
Foundation of Knowledge in the Natural Sciences

Objectives:

1.1 know some of the fundamental ideas of chemistry:

- 1.1.1 structure and composition of matter, and the interaction among its components
- 1.1.2 conservation of matter and energy in reaction systems
- 1.1.3 chemical reactions are expressed in terms of the symbol system and the language of chemistry
- 1.1.4 factors associated with the interaction of matter
- 1.1.5 atterns of chemical and physical properties as they relate to the developmentof laws, theories and models

1.2 view such knowledge as part of a systematic explanation of natural phenomena

1.3 use the knowledge learned. when interpreting natural phenomena

Goal 2
Nature of Science

Objectives:

2.1 understand that science is a disciplined way to develop explanations for the events and objectives of the natural world:

- 2.1.1 empirical data plays an central role in the development of scientific knowledge
- 2.1.2 scientific explanations are developed through interpretations and conceptual inventions which are theoretical in nature
- 2.1.3 theories may subsequently be supported or refuted by the results of experimentation

2.2 develop skill in the processes of science: questioning, acquiring data, proposing ideas, designing experiments. gathering, processing, and interpreting data into a unified theory

2.3 recognize that scientific knowledge is cumulative and subject to change.

Goal 3
Science and Technology

Objectives:

3.1 view technology as a means of solving practical problems

3.2 know that the scope of technological development includes both techniques and products

3.3 use scientific knowledge to explain and understand technological devices

3.4 know that science can be used to advance technology and that technology can be used to advance science

3.5 become familiar with some of the existing and emerging technologies.

Goal 4
Science, Technology, Society

Objectives:

4.1 understand that science and technology influence and are influenced by societal issues

4.2 understand that many of the effects of science and technology on society are unforeseen

4.3 become aware of the interaction of science and technology with societal factors such as economic, political, ethical and moral forces

4.4 appreciate the societal impact of technological processes, techniques and products

4.5 be aware that trade-offs are made in order to arrive at workable circumstances involving science and technology in society

4.6 evaluate the appropriateness of various societal decisions in terms of related scientific and technological thinking.

UNIT I: PERIODIC TABLE

OVERVIEW:

The focus of this unit is on understanding the basic structure of matter, with an emphasis on the nature of science.

CONTENT:

Concepts

1. The concept of periodicity among the elements developed over time as scientists gathered empirical data about the elements.

    a. Know that Mendeleev formulated the first periodic table by categorizing the elements according to similar properties.

    b. Utilize chemical and physical properties about the elements to understand the periodicity of the modern periodic table.

    c. Know the names and symbols for common elements.

    d. Identify elements within classification categories of the periodic table.

    e. Know the common family names.

    f. Realize the relationship between chemical families and the physical and chemical properties of atoms.

    g. Understand that properties show periodic variation as a result of changing electron configuration.

2. The modern model of the atom is based on the empirical data and insightful analysis of many scientists.

    a. Know that the atom consists of a positively charged nucleus surrounded by negatively charged electrons.

    b. Know that valence electrons are electrons involved in chemical reactions.

    c. Know the past and present models of the atom.

d. Recognize that some early theories of atomic structure were refuted by experimental results.

e. Describe the major particles within the atom and know their charges.

f. Describe the ocet rule.

g. Understand the Lewis Diagram as a model for the valence electrons of an atom.

Skills:

1. Conduct tests for metals, non-metals and metalloids as well as for polar and non-polar covalent and ionic compounds.

2. Draw atomic diagrams with electrons in energy levels for the first 20 elements.

3. Draw Lewis Diagrams for representative elements from group I to VIIIA.

Attitudes:

1. Appreciate that the development of the modern periodic table was aided by the rapid discovery of elements in the early 1800's.

2. Recognize that the periodic table has certain limitations when used to make predictions.

3. Appreciate that our society makes use of some pure elements, in particular metals such as aluminum and iron, and gases such as neon and oxygen; but many more are useful only as compounds, such as table salt, water, ammonia, acids and bases.

4. Appreciate that chemical industries play an important role in converting compounds to elements which are useful to society.
(examples: the refining of metal ores and the process of electroplating)

5. Appreciate that knowledge about the atom has always been derived from experimental research which relied on indirect observation.

6. Appreciate that models, by analogy, simplify scientific phenomena.

7. Realize that many analytical methods and technologies are based on our knowledge about the atom.

UNIT II: BONDING

OVERVIEW:

The focus of this unit is to look at the interaction between atoms with an emphasis on the nature of science.

CONTENT:

Concepts

1. Atoms bond with each other to attain a more stable, but lower, energy state and to complete outer energy levels.

    a. Describe covalent bonding between nonmetallic atoms.

    b. Know the definition of the electronegativity of elements.

    c. Know the trends of electronegativity within the periodic table.

    d. Predict, and explain, structural formulas for molecular compounds by using Lewis Diagrams.

    e. Define an ion.

    f. Know the meaning of the terms oxidation and reduction.

    g. Know the names, colors and formulae of common simple and complex ions.

    h. Describe ionic bonding between elements of different electronegativities.

    i. Understand the ratio of ions within empirical formulae of ionic compounds.

    j. Know the basis for the classification system of inorganic molecular compounds.

    k. Distinguish between an electrolyte, an electrolytic solution and a non-electrolytic solution.

    l. Understand the naming system for simple hydrocarbons.

    m. Know the names of commonly used organic compounds.

Skills:

1. Predict the name and charge of simple metallic and non-metallic ions.

2. Write empirical formulae of ionic compounds.

3. Predict and draw Lewis Diagrams and Structural Diagrams for simple ions and covalent molecules.

4. Name simple hydrocarbons and common organic compounds, as well as common acids and common binary molecular compounds.

Attitudes:

1. Appreciate that the combined state of atoms is predicted by evidence about the composition of matter.

2. Appreciate that the vast majority of molecular compounds in nature are organic.

3. Appreciate that, in the market place, many compounds have common names.
   (examples: ammonia and natural gas)

4. Realize that many of the chemicals currently used by society; such as plastics, insecticides and medicines, are organic compounds.

5. Realize that careers in many industries involve the manipulation of organic and inorganic molecules.
   (examples: plastics, fertilizer and cosmetics manufacture as well as the refining of crude oil)

6. Appreciate that many common chemicals such as fertilizers, table salt and food additives contain simple and complex ions.

UNIT III: CHEMICAL INTERACTIONS

OVERVIEW:

The focus of this unit is a study of the common ways in which elements and compounds interact in chemical reactions, and that all chemical reactions involve a balance between reacting particles and product particles. This unit emphasizes the role of science and technology in societal issues.

CONTENT:

Concepts

1. A chemical equation is a concise method of describing the progress of a chemical reaction.

    a. Define reactants and products.

    b. Know the definition of a mole.

    c. Interpret reactants and products in molar terms.

    d. Understand stoichiometric relationships within a chemical reaction.

    e. Apply stoichiometric techniques to balance simple chemical equations.

    f. Relate chemical equations to local industrial processes.
    (examples: fertilizer production, ethanol production and cracking of hydrocarbons)

    g. Describe chemical reactions in terms of rate and energy.

    h. Understand how science and technology influence each other.

2. Chemical reactions can be classified to facilitate making predictions.

    a. Recognize and predict the products of a simple composition, a simple decomposition, a single replacement and a double replacement reaction.

    b. Know that many compounds react with oxygen.

    c. Predict the products of a simple hydrocarbon combustion, a substitution and an addition reaction.

d. Recognize that society tries to prevent some reactions from taking place and to promote others.
(examples: corrosion of metals and decomposition of metal ores by electrolysis)

e. Recognize the evidence for the occurrence of chemical reactions.

f. Understand the relationship of reaction types to societal uses.
(example: the importance of precipitation reactions to water treatment)

g. Understand the relationship of acid-base reactions to many societal uses.
(example: household products)

h. Relate the products of combustion to the environment.
(examples: air pollution, acid rain, thermal pollution and 'greenhouse effect')

Skills:

1. Write balanced chemical equations for the required reactions.

2. Predict the products of chemical reactions.

Attitudes:

1. Appreciate that classification can lead to oversimplification.

2. Appreciate the safety precautions which must be taken when handling many chemical compounds.

3. Appreciate Alberta's dependence on the oil and gas industry.

4. Realize that there is an interaction between chemical reactions and the environment.

UNIT IV: QUANTITATIVE ANALYSIS

OVERVIEW:

The focus of this unit is the mole concept and its application to solutions and chemical reactions, with an emphasis on the relationship between technology and science.

CONTENT:

Concepts

1. The mass of one mole is called the molar mass.

    a. Calculate molar masses using correct units and an awareness of significant digits.

    b. Calculate and find the mass of a specific number of moles of a substance.

    c. Calculate the number of moles in a given mass of a substance.

2. The concentration of a solution is expressed in appropriate units.

    a. Define solute and solvent and understand their relationship.

    b. Relate the dissolving of a solute in a solution to the resulting species in solution.

    c. Understand that dissolving involves energy changes.

    d. Calculate the molar concentration of solutions and aqueous ionic species.

    e. Relate different concentration units to commercial use.
    (example: percent by volume)

    f. Calculate molar solubility of a pure substance from empirical data.

    g. Prepare solutions of specified concentration using a pure substance or stock solution.

    h. Describe solubility as an equilibrium condition.

3. Stoichiometry involves the use of mole calculations to determine the quantities of substances used and produced in chemical reactions.

    a. Solve mass and solution stoichiometric problems.

    b. Understand that stoichiometry problems assume 100% reaction.

Skills:

1. Perform all mole-related calculations.

2. Use the calculator efficiently to aid in solving stoichiometry problems.

3. Use appropriate laboratory equipment in performing quantitative analysis experiments.

Attitudes:

1. Appreciate how advances in technology have increased speed and accuracy in measurement.
   (example: electronic balance)

2. Appreciate that only slow and careful laboratory techniques produce accurate results.

3. Understand the major role of solutions in technology and their great impact on the environment.
   (examples: the pulp and paper and electroplating industries)

UNIT I: REACTION DYNAMICS

OVERVIEW:

The focus of this unit is on reaction kinetics and equilibrium, with emphasis on the nature of science.

CONTENT:

Concepts

1. By gathering empirical data, the factors that influence reaction rates can be analyzed. Theories and models have been developed to explain these factors.

    a. Observe different factors which influence reaction rates.

    b. Utilize the Collision Theory, knowledge about activation energy, as well as potential and kinetic energy diagrams, to explain the factors which affect reaction rates.

    c. Understand the application of reaction kinetics to practical situations. (examples: the use of inhibitors in food preservation, the use of catalysts in industrial reactions such as in the Haber process)

2. Most reactions can be expressed as a dynamic equilibrium.

    a. Recognize that equilibrium involves the constancy of macroscopic properties in a closed system.

    b. Represent a state of equilibrium by using appropriate symbols.

    c. Explain that an equilibrium system achieves a compromise between minimum energy and maximum randomness.

    d. Show how Le Chatelier's Principle is used to predict shifts in equilibria.

    e. Show how the magnitude of K_{eq} can be used to predict the extent of the equilibrium.

    f. Know the meaning of specific equilibria expressions: K_A, K_B, K_W and K_{SP}.

    g. List the industrial processes which apply Le Chatelier's Principle. (example: the Haber process)

Skills:

1. Analyze and interpret different variables which influence reaction rates.

2. Predict equilibria shifts using Le Chatelier's Principle.

3. Write K_{eq} expressions and calculate their magnitude using empirical data.

Attitudes:

1. Appreciate the relationship of reaction kinetics to everyday processes (examples: spontaneous combustion, food preservation, gas explosions) and industrial processes (examples: catalytic converters, petrochemical industry, Haber process).

UNIT II: ACIDS AND BASES

OVERVIEW:

This unit focuses on the characteristics of acids and bases with an emphasis on the role of science and technology in societal issues.

CONTENT:

Concepts

1. Acids and Bases are defined both empirically and theoretically.

    a. Apply the Arrhenius and Brönsted-Lowry definitions to explain acidic and basic properties.

    b. Understand the meaning of pH and its use in the measurement of hydronium ion concentration.

    c. Evaluate the appropriateness of societal decisions regarding the pH balance in Canadian lakes and rivers.

    d. Calculate the pH of acid and base solutions of varying strengths.

    e. Calculate K_A and K_B using empirical data.

    f. Calculate the pH of a mixture of a strong acid with a strong base.

    g. Relate acids and bases to many household products.

2. Acids and Bases react to reach equilibrium.

    a. Apply the Brönsted-Lowry theory and the relative strength of acids to predict the most likely reaction.

    b. Understand indicators and how they work.

    c. Define a buffer and a buffered system.

    d. Relate the role of the buffer to living systems.

    e. Understand a titration as a technological process used in the quantitative measurement of acid/base reactions.

    f. Determine a suitable indicator for a titration using a given titration curve.

g. Identify the correct equipment and use it in performing acid-base titrations in the laboratory.

h. Recognize the relationship among science, technology and economics in the area of acid-base reactions..

Skills:

1. Utilize the calculator in doing pH and hydronium ion concentration calculations, using logarithms and antilogarithms.

2. Select the required equipment and use the correct procedure in performing acid/base titrations in laboratory.

Attitudes:

1. Appreciate the need for the safe handling and disposal of acids and bases.

2. Appreciate the effect on society of acid-base technological processes, techniques and products; from the viewpoints of the economy, the environment and agriculture.

UNIT III: ELECTROCHEMISTRY

OVERVIEW:

The focus of this unit is on the understanding of oxidation-reduction reactions with the emphasis on the relationship between technology and science.

CONTENT:

Concepts

1. Redox reactions are equilibrium systems that favour products and involve a transfer of electrons.

    a. Define the terms oxidation, reduction, reducing agent, oxidizing agent and oxidation number.

    b. Know that oxidation occurs simultaneously with reduction.

    c. Identify the oxidizing and reducing agents in chemical reactions.

    d. Apply standard reduction or oxidation potential tables to determine whether a reaction is spontaneous or nonspontaneous.

    e. Write balanced redox equations using half reactions and oxidation numbers.

2. An electrochemical cell converts chemical energy into electrical energy while an electrolytic cell converts electrical energy into chemical energy.

    a. Know how an electrochemical cell works.

    b. Predict the products of electrochemical and electrolytic cells..

    c. Relate electrolysis to many industrial and commercial applications.
    (examples: electroplating, metal recovery from solution and refining of metal ores)

3. Stoichiometry is used to determine quantitative relations in redox reactions.

    a. Understand the purpose of a redox titration and the related quantitative calculations.

    b. Understand quantitative calculations involving electrochemical and electrolytic cells.

c. Relate quantitative calculations to technological techniques.

Skills:

1. Construct a standard reduction or oxidation potential table from student obtained empirical data.
2. Construct an electrochemical cell and measure its potential.
3. Construct an electrolytic cell to test predictions.
4. Perform quantitative calculations involving electrochemical and electrolytic cells.
5. Draw and label an electrochemical cell.
6. Perform a redox titration in the laboratory and do the appropriate calculations.

Attitudes:

1. Appreciate that many reactions in nature can be classified as redox reactions. (examples: respiration, photosynthesis and metal corrosion)
2. Appreciate the wide usage of electrochemical cells in everyday life and realize that their disposal can be an environmental concern.

UNIT IV: ENERGETICS

OVERVIEW:

The focus of this unit is on the study of energy transformations and the emphasis is on the relationship between technology and science.

CONTENT:

Concepts

1. Energy can be converted from one form to another and still be conserved.

    a. Recognize that chemical and nuclear energies can be converted to other forms of energy.

    b. Relate the total energy of a molecule to the sum of its potential and kinetic energies.

    c. Analyze technologies involved with renewable and nonrenewable energy sources.
    (examples: petrochemical industry and pulp and paper industry)

    d. Realize that many forms of energy require technological intervention in order to convert them to useful forms.
    (example: crude oil refining)

2. Calorimetry is a major technological process used in the quantitative measurement of the heat of reaction.

    a. Understand that the molar heat of a phase and chemical change can be determined empirically.

    b. Understand that Hess' Law can be derived empirically.

3. The heat of formation is the energy required or released when a compound is formed from its constituent elements.

    a. Predict heats of reaction using Hess' Law and heats of formation tables.

    b. Represent the heat of reaction using potential energy diagrams, chemical equations and ΔH notation.

c. Understand that heat of formation tables are based on an arbitrary scale.

d. Use knowledge about quantitative energy changes to explain the operation of technological devices.
(examples:)

e. Discuss ways to make efficient use of limited natural resources.

4. Nuclear energy has an impact on us.

a. Understand that nuclear chemistry is concerned with changes that occur in the nucleus of an atom.

b. Understand that nuclear reactions involve the transformation of a small amount of matter into a large amount of energy.

c. Define the terms isotope, fission, fusion, radioactive decay and transmutation.

d. Recognize the CANDU reactor as a Canadian-designed nuclear reactor.

e. Analyze the impact of nuclear energy on technology and on society.

Skills:

1. Perform calculations to find the heat of reaction using molar heats of formation and Hess' Law.

2. Empirically determine molar heats and Hess' Law.

3. Draw energy diagrams of energy changes for phase, chemical and nuclear reactions.

4. Balance a nuclear equation using atomic numbers and moles.

Attitudes:

1. Appreciate the overwhelming evidence of energy transformations existing in everyday life.
   (example: the water cycle, the burning of fossil fuels)

2. Realize that increased utilization of resources may result in scarcity, depletion and environmental damage; and that this may necessitate a search for alternatives.

3. Appreciate the problems associated with nuclear technology.
   (examples: nuclear waste disposal, nuclear weapons)

4. Appreciate the benefits associated with nuclear technology.
   (examples: radio-active isotopes in agriculture and medicine, fusion as an energy source)

LB 1629-5 A3 A35 1978 GR-10-12
ADD-CHEM- 1988
PROGRAM OF STUDIES FOR SENIOR
HIGH SCHOOLS --
39897100 CURR HIST

000026489492

DATE DUE SLIP

F255